

# Role of T & E



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June 2, 2011

| Report Documentation Page  |                                    |                                     | Form Approved<br>OMB No. 0704-0188                             |                                  |                                 |
|--|------------------------------------|-------------------------------------|--|----------------------------------|---------------------------------|
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| 1. REPORT DATE<br><b>02 JUN 2011</b>   |                                    | 2. REPORT TYPE<br><b>N/A</b>        |  | 3. DATES COVERED<br><b>-</b>     |                                 |
| 4. TITLE AND SUBTITLE<br><b>Role of Test &amp; Evaluation</b>  |                                    |                                     | 5a. CONTRACT NUMBER  |                                  |                                 |
|  |                                    |                                     | 5b. GRANT NUMBER   |                                  |                                 |
|  |                                    |                                     | 5c. PROGRAM ELEMENT NUMBER                                     |                                  |                                 |
| 6. AUTHOR(S)<br><b>Sid Shidfar</b>   |                                    |                                     | 5d. PROJECT NUMBER   |                                  |                                 |
|  |                                    |                                     | 5e. TASK NUMBER  |                                  |                                 |
|  |                                    |                                     | 5f. WORK UNIT NUMBER   |                                  |                                 |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)<br><b>US Army RDECOM-TARDEC 6501 E 11 Mile Rd Warren, MI 48397-5000, USA</b>  |                                    |                                     | 8. PERFORMING ORGANIZATION REPORT NUMBER<br><b>21881</b>       |                                  |                                 |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)<br><b>US Army RDECOM-TARDEC 6501 E 11 Mile Rd Warren, MI 48397-5000, USA</b>   |                                    |                                     | 10. SPONSOR/MONITOR'S ACRONYM(S)<br><b>TACOM/TARDEC/RDECOM</b> |                                  |                                 |
|  |                                    |                                     | 11. SPONSOR/MONITOR'S REPORT NUMBER(S)<br><b>21881</b>         |                                  |                                 |
| 12. DISTRIBUTION/AVAILABILITY STATEMENT<br><b>Approved for public release, distribution unlimited</b>  |                                    |                                     |  |                                  |                                 |
| 13. SUPPLEMENTARY NOTES<br><b>The original document contains color images.</b>   |                                    |                                     |  |                                  |                                 |
| 14. ABSTRACT   |                                    |                                     |  |                                  |                                 |
| 15. SUBJECT TERMS  |                                    |                                     |  |                                  |                                 |
| 16. SECURITY CLASSIFICATION OF:  |                                    |                                     | 17. LIMITATION OF ABSTRACT<br><b>SAR</b>                       | 18. NUMBER OF PAGES<br><b>33</b> | 19a. NAME OF RESPONSIBLE PERSON |
| a. REPORT<br><b>unclassified</b>   | b. ABSTRACT<br><b>unclassified</b> | c. THIS PAGE<br><b>unclassified</b> |  |                                  |                                 |

# Overview

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- T&E's Role
  - Acquisition Lifecycle
  - Systems Engineering
- DoD T&E Types & Differences
- Test & Evaluation Planning

# What is Test & Evaluation?

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- **Principal tool to measure progress in system development and to provide essential information to acquisition decision makers**
- **Conducted to...**
  - **Facilitate learning**
  - **Assess technical maturity & interoperability**
  - **Facilitate integration into fielded forces**
  - **Confirm performance**
  - **Reduce Risk**

# T&E Contributions During Concept & Technology Development

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- **At Milestone A...**
  - **Concept development team and the integrated test team...**
  - **Develop T&E Strategy (TES)**

# T&E Contributions During Engineering & Manufacturing Development Phase

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- **At Milestone B...**
- **Executed by a T&E IPT...**
  - **TEMP**
  - **Coordinated Test Events**
  - **Developmental Testing**
  - **Operational Assessments**
  - **Resources**

# T&E Contributions During Production & Deployment

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- **Prior to LRIP:**
  - **DT&E**
    - How well did system meet spec?
    - System safe and ready for LRIP and IOT&E?
- **Prior to FRP:**
  - **OTA conducts IOT&E**
    - Evaluate Operational Effectiveness & Suitability
  - **LFT&E Completed**
    - Evaluate Vulnerability, Survivability, Lethality, and Recoverability

# T&E Contributions Post FRP

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- **Follow-on Operational Test and Evaluation (FOT&E)**
- **Residual DT&E and Technical Testing**



# T&E Role In Requirements Analysis

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- As Member of Acquisition IPT:
  - Advise on testability of requirements
  - Advise on risk on testing requirements
  - Determine if the threat in the STA can be portrayed or simulated
  - Help prepare the Test & Evaluation Master Plan (TEMP)

# Verification Loop

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- Each requirement must be verifiable
- Verification confirms that solution meets requirements
- Types of verification
  - Inspection
  - Demonstrations
  - Simulations / analysis
  - Certifications
  - Test

# Types of DoD T&E

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- Contractor Testing
- Developmental T&E (DT&E)
- Operational T&E (OT&E)
- Operational Assessment (OA)
- Combined Testing
- Joint Testing (with other Services)

**DT&E**

**OT&E**

**Contractor**

**Govt.**

**IOT&E**

**FOT&E**

**Combined Testing**

**DT&E**

**OT&E**

**EOA**

**OA**

# T&E IPT

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- Empowered by PM
- Includes representatives from organizations involved with test program, such as:
  - PMO/TARDEC, Test Agencies (DT/OT), Operating Commands/User Representatives, Logistics/TACOM, Contractors, Services & OSD
  - Integrates test requirements & assists in TEMP development

# Test Conduct

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- DT&E
  - Technical
  - Controlled environment
  - Specification tested
  - Technical personnel
- OT&E
  - Realistic environment
  - Typical operators & maintainers
  - Simulated enemy engagements

# Measurements

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- **DT&E**
  - **Specific parameters**
    - **Gross Vehicle Weight (GVW)**
    - **Fuel Consumption**
    - **Drawbar Pull**
  - **Tests must be repeatable**
- **OT&E**
  - **Generally specific measurements not taken**
  - **Create combat conditions & observe results**
  - **Test not repeatable, interactions usually unique**

# *What is a TEMP ?*

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- ▶ Executive level strategy and basic planning document for all life cycle T&E for a particular system acquisition
- ▶ Overall T&E structure, major elements, and objectives
- ▶ Consistent with Acquisition Strategy and SEP
- ▶ Sufficient detail to permit planning for timely availability of test resources required to support the T&E program
- ▶ Road Map for integrated: Simulation, test, and evaluation plans, Resource requirements, Schedules



# Test Plans Should Include...

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- **Test Objectives**
- **MOE's, MOP's and Measures of Suitability**
- **Planned Operational Scenarios**
- **Threat Representations**
- **Targets**
- **Resources**
- **Test Limitations**
- **Data Collection, Certification, and Analysis Procedures**

# Evaluation Planning

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- Identify:
  - Technical Parameters
  - Critical Operational (Mission) Issues
  - Data requirements for each parameter & issue
- Develop Baseline Correlation Matrix for:
  - MOP, MOE, MOS, COIC
  - Analysis technique for each parameter & issue

# ATEC Organizations

**ATEC**

(Army Test & Evaluation Command)  
Independent Evaluator

**DTC**

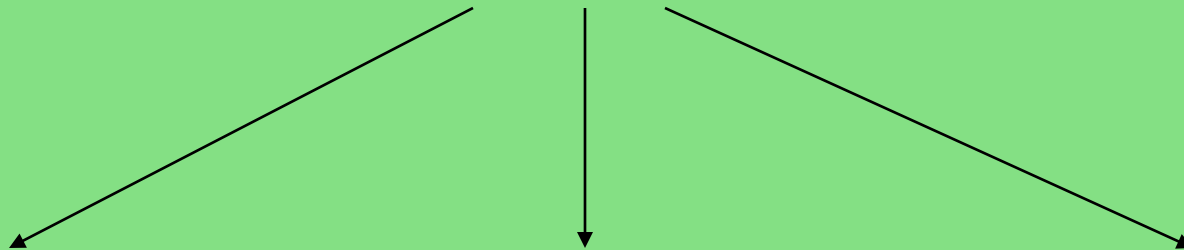
(Development Test Command)

**AEC**

(Army Evaluation Center)

**OTC**

(Operational Test Command)



# Typical Technical Tests

| <u>Test Title</u>                        | <u>TOP #</u>     |
|--|------------------|
| Transportability                         | 1-2-500          |
| Endurance & Reliability                  | 2-2-507, 2-1-001 |
| Noise                                    | 3-2-811          |
| Fording                                  | 2-2-612          |
| Vehicle Fuel Consumption                 | 2-2-603          |
| High Altitude Effects                    | 2-2-702          |
| Standard Obstacles                       | 2-2-611          |
| Acceleration- Maximum & Minimum Speeds   | 2-2-602          |
| Gradeability and Slide Slope Performance | 2-2-610          |
| Center of Gravity                        | 2-2-800          |
| Steering                                 | 2-2-609          |

## **Typical Operational Tests**

### **Evaluates:**

- **Offensive Role**
- **Defensive Role**
- **Command and Control**
- **Optimum number of Systems per unit**
- **Battle Drill Evaluation**
- **Adequacy of Support Structure**
- **Fightability**

# Reliability

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**Reliability is the probability of performing a given function for a specified length of time under stated conditions.**

**Example:**

$$R = e^{-\text{Mission Length}/\text{MTBF}}$$

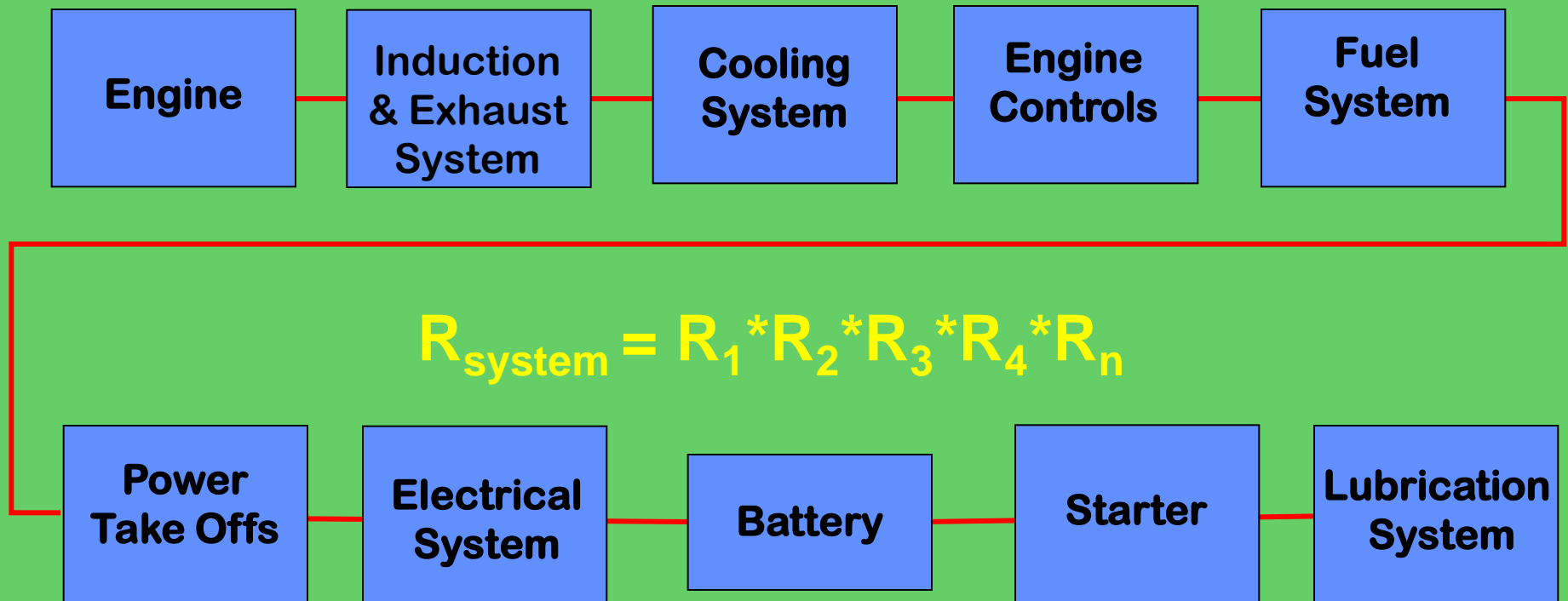
$$R = 95\%$$

**Mission Length = 300 Miles**

**MTBF = 5800 Miles**

**Total Operating Time (Hours, Miles, Cycles, Etc.)**  
**Total Failures**

# Reliability Block Diagram



# Maintainability

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- Maintainability is the probability that a system can be restored to its specified operational condition within a specified period.



# Availability

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- Availability is the probability that at any point in time the system is either operating satisfactorily or ready to be placed in operation on demand when used under stated conditions.

# AVAILABILITY

$$A_i = \frac{MTBF}{MTBF + MTTR}$$

$A_i$  - Inherent Availability  
 $A_o$  - Operational Availability

$$A_o = \frac{MTBM}{MTBM + MMT + MLDT + LDT + ADT}$$

MTBF - Mean Time Between Failure  
MTTR - Mean Time to Repair  
MLDT - Mean Logistics Down Time  
MTBM - Mean Time Between Maintenance  
MMT - Mean Maintenance Time  
LDT - Logistics Delay Time  
ADT - Administrative Delay Time

# HOW RAM BENEFITS THE FIELD

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- Increased combat capability
  - Improve operational readiness / availability
  - Better system utilization
  - Higher probability of mission success
- Reduced Life Cycle Costs
  - Less maintenance manning
  - Decreased logistics support footprint

**\*\* RAM characteristics are not important in themselves. Achieving the objectives listed herein is what is important**

## Perryman Test Ranges



## Munson Test Ranges



## Test Instrumentation Facility



## Vulnerability / Survivability Range



## Hi Speed Electronic Imaging





## Air Transport (External)



## Automotive Tilt Table

